Homeland Security
Science and Technology

Summary

U.S. Department of Homeland Security
SAVER
System Assessment and Validation for Emergency Responders

The U.S. Department of Homeland Security (DHS) established the System Assessment and Validation for Emergency Responders (SAVER) Program to assist emergency responders making procurement decisions.

Located within the Science and Technology Directorate (S&T) of DHS, the SAVER Program conducts objective operational tests on commercial equipment and systems and provides those results along with other relevant equipment information to the emergency response community in an operationally useful form. SAVER provides information on equipment that falls within the categories listed in the DHS Authorized Equipment List (AEL).

The SAVER Program is supported by a network of technical agents who perform assessment and validation activities. Further, SAVER focuses primarily on two main questions for the emergency responder community: "What equipment is available?" and "How does it perform?"

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Evaluation of Blast Resistant Trash Receptacles

This SAVER Summary contains information on the comparative analysis project conducted by the Naval Explosive Ordinance Disposal Technology Division at the Army Research Lab in Blossom Point, Maryland. The Test Results of Blast Resistant Trash Receptacles *report is available by request at* https://www.rkb.us/saver.

Background

Through tasking and funding provided by the United States Department of Homeland Security, Office of State and Local Government Coordination and Preparedness, Systems Support Division, the Naval Explosive Ordnance Disposal Technology Division tested 15 different blast resistant trash receptacle (BRTR) models from four vendors: Master Lite Security, American Innovations, Mistral Security Group, and BlastGard International. A total of 75 BRTR tests were conducted during the months of June, July, and September 2005 at the Army Research Laboratory testing facility in Blossom Point, Maryland.

The purpose of the testing was to evaluate the claims made by each vendor using bare (i.e., nonfragmenting) explosive charges and a fragmenting pipe bomb. The bare charges were constructed to match the maximum explosive limit of the containers, and the pipe bomb was modeled after data obtained from the Bureau of Alcohol, Tobacco, and Firearms' bomb data repository.

The charges were detonated in the following five locations inside of each container:

1) Center of the receptacle, halfway up the interior, no wall contact.

2) In contact with the wall on the inner seam, half way up the interior.

3) In contact with the wall 180 degrees opposite the inner seam, half way up the interior.

4) In contact with the wall and bottom of the receptacle, 90 degrees from the inner seam.

5) Pipe bomb placed in center of receptacle, halfway up the interior, no wall contact.

Free-air detonations of all charge sizes were also performed in order to determine the pressure differences between an unobstructed detonation and a detonation occurring inside of a BRTR.

The receptacles included under this effort were: Master Lite Security's Blastbuster; American Innovations' Defender, Protector, and Guardian models; Mistral Security Group's BG30and BG40 models (with and without lids); and BlastGard International's MTR 91 and MTR 101 models (see images 2 & 3). Table 1 shows the physical characteristics of each BRTR model.

In the absence of Government or industry standards governing the design or performance of BRTRs, each vendor was evaluated against its own claims. Claims were obtained from each vendor's Web site or from literature provided to the Government. Because most of the claims were subjective in nature, testable parameters were developed using the source documents cited above. Table 2 summarizes the author's interpretation of the claims that each vendor was evaluated against.

It should be noted that the test protocols under which the containers were tested may have been different than those used by the individual vendors in developing their claims. As such, the results obtained during this testing may be different than those obtained and reported by the vendors in their claims.

The following methods were used to verify BRTR vendors' claims:

- Real-time video and high-speed video recorded the blast and effects of the blast products and fireball.
- Digital pictures were taken before and after the explosive event to document damage to witness panels and containers.
- Hardwood panels were used to indicate fragmentation resulting from the blast.
- Silhouettes (used during pipe bomb tests only) captured blast effects.
- Pressure sensors measured overpressure versus time at pre-determined distances to determine the pressure difference between open air detonations and detonations inside of BRTRs.
- Diameters and heights of the receptacle were measured before and after the explosive event to record the receptacle deformation.

All of the containers evaluated under this effort provide some measure of protection against explosive effects. However, the performance was varied amongst the different vendors and even amongst the different products provided by a single vendor.

As such, it is essential that any organization considering purchasing BRTRs fully understand the general capabilities and limitations of the products as well as the specific limitations of the exact product being considered.

Careful consideration should be given to the exact placement of the containers, especially if they are going to be placed inside enclosed structures such as train or bus stations. Since most of the blast products are directed (focused) vertically, significant damage could occur to overhead structures. In some instances, it is possible that the resulting damage could actually be worse than if the explosion would have occurred outside of a BRTR. This is an area that warrants further investigation.

Table 3 summarizes the results of this effort. A red box indicates the claim was not met. A green box indicates the claim was met. An NA in the box indicates that the vendor made no claim for that particular item.

Mixed results were obtained with respect to the direction of blast products. Containers without lids were generally more effective in directing the blast products vertically. It was observed on high-speed video that a portion of fireball extended horizontally and downward on all of the containers containing a lid (see image 1).

On several tests, this portion of the fireball fully engulfed the container and surrounding area out to approximately five feet. This effect was contributed to the initial resistance provided by the lid. In all cases, the lid ultimately came off the container allowing the majority of the remaining blast products to be directed vertically.

Vendor	Model	Weight (lb)	Trash Capacity (gallons)	Exterior Diameter (in.)	Exterior Height (in.)
Master Lite Security	Blastbuster	650	30	22	36
American Innovations	Guardian	1400	40	30	38
	Protector	1640	40	30	38
	Defender	1900	40	30	38
Mistral Security Group (lidded and non-lidded)	BG30-1.6	441	30	27	37
	BG30-3.0	529	30	27	37
	BG30-5.0	914	30	27	37
	BG40-1.6	485	40	28	39
	BG40-3.0	617	40	28	39
BlastGard International	MTR 91	1400	40	30	52
	MTR 101	1900	40	30	52

Table 1. Physical Characteristics of Receptacles Tested

Vendor	Vendor Claim				
Vendor	Receptacle Will Direct Blast Products (Fireball) Upward	Receptacle Will Not Produce Secondary Fragments	Receptacle Will Reduce Radial Blast Pressure	Receptacle Will Contain Primary Pipe Bomb) Fragments	Bare Charge Will Not Breach Outer Wall of Receptacle
Master Lite Security	X	X	X	NA	NA
American Innovations	X	X	X	X	X
Mistral Security-Group	X	X	X	NA	X
BlastGard International	X	X	X	X	X

Table 2. BRTR Vendors' Claims

	Vendor Claim				
Vendor	**Receptacle Will Direct Blast Products (Fireball) Upward**	**Receptacle Will Not Produce Secondary Fragments**	**Receptacle Will Reduce Radial Blast Pressure**	**Receptacle Will Contain Primary Pipe Bomb) Fragments**	**Bare Charge Will Not Breach Outer Wall of Receptacle**
Master Lite Security (Blastbuster Model)	Blast not directed upward in all 4 tests	Fragments produced in all 4 tests	Blast pressure reduced in all 4 tests	NA	NA
American Innovations (Defender, Protector, and Guardian models)	Blast not directed upward in 2 out of 12 tests	Fragments not produced in all 12 tests	Blast pressure reduced in all 12 tests	Pipe bomb Fragments contained in all 3 tests	Outer wall breached in 3 out of 12 tests
Mistral Security-Group (Lidded BG30 and BG40 Models)	Blast not Directed upward in 2 out of 20 tests	Fragments produced in 1 out of 20 tests	Blast pressure reduced in all 16 tests	NA	Outer wall breached in 9 out of 16 tests
Mistral Security-Group (Non-lidded BG30 and BG40 Models)	Blast not directed upward in 2 out of 20 tests	Fragments produced in 1 out of 20 tests	Blast pressure reduced in all 20 tests	NA	Outer wall breached in 8 out of 20 tests
BlastGard International (MTR91 and MTR 101Models)	Blast not directed upward in all 8 tests	Fragments produced in all 8 tests	Blast pressure reduced in all 8 tests	Pipe bomb Fragments contained in both tests	Outer wall breached in 3 out of 8 tests

Table 3. Claims and Results of BRTR Vendors

For those containers not having a lid, most, if not all, of the blast products were vented vertically throughout the duration of the event. The two American Innovations and two Mistral non-lidded tests where the blast products were not directed upward were caused by breeches in the containers' outer wall. It should be noted that for this testing, the outer wall was defined as the side and bottom of the container.

Mixed results, also related to the lids, were obtained with respect to the production of secondary fragments. Secondary fragments are defined as those fragments created by the container itself. With the exception of the Master Lite Security's Blastbuster, very few of the BRTRs without lids produced fragments from the metal container. However, since the lid is considered part of the container and the lid came off during every test, those containers having a lid produced secondary fragments by definition. The lid-related fragments observed during testing varied from mostly intact, although somewhat mangled, lids that were generally launched vertically (as was the case with Mistral's metal-lidded containers) to large and small fragments that were spread over much of the 30-foot test arena and surrounding areas.

The latter case occurred during testing of both BlastGard configurations—the MTR 91 and 101—which contained a large, relatively heavy plastic lid. The significant difference between the two types of secondary fragments was the amount of damage caused to the witness panels. The lids from Mistral's containers produced very little, if any, damage to the witness panels since they mostly stayed intact. BlastGard's lids, however, were completely destroyed, consistently littering the surrounding area with fragments and typically producing significant damage to the witness panels (see images 2 and 3).

All products were generally effective in reducing the blast pressure when compared to the same size charge detonated in free air. The net effect of this would be less severe physiological damage at a given distance (e.g., standing in the same location you may experience lung damage for an exposed bare charge detonation but only eardrum rupture if the same size charge detonates inside a BRTR).

Pressure differences beyond 30 ft were not appreciable; however, it should be noted that the pressures measured beyond this distance fell below the error associated with the pressure gauges.

Image 1. Detonation

The products of both vendors claiming to be able to contain primary fragments—American Innovations and BlastGard—successfully met that claim against the pipe bomb tested. Even those containers from vendors not making that claim generally performed well in the test. This is not surprising, given the relatively small amount of explosives in the pipe bomb compared to the amount of explosives the BRTRs were designed to withstand.

It is recommended that future tests include fragment-producing devices using explosive amounts at the limits specified by the vendor. This would better test the limits of the containers while still reflecting realistic improvised explosive device configurations.

Finally, all of the 15 different models tested experienced some level of structural failure on at least one of four bare explosive tests conducted. Failures ranged from almost complete destruction—as was the case with Master Lite Security's Blastbuster—to minor failures of the bottom weld seam. The most common failure point was position four, the intersection of the bottom of the container and the side wall (see images 4 and 5). Although this was the most

Image 2. MTR 101 breached in bottom charge location test

Image 3. Charge produced large hole in lidded BG40-1.6

common failure point, the resultant consequences were typically not severe. In most cases, secondary fragments were not produced, minimal amounts of blast products escaped, and no discernable increases in pressures were observed compared to those containers that did not fail.

Although these validation tests demonstrated that none of the containers tested met all the manufacturers' claims, each container provides some measure of protection against blast and explosive effects. However, it is essential that organizations purchasing these products fully understand the capability and limitations of bomb resistant trash receptacles in general, and the specific product to be purchased in particular. There are currently no industry standards that cover the performance or testing of blast resistant trash receptacles. Manufacturers of these products design, specify container performance, and test their products differently, often using vague or general statements when describing the ability of their products to protect against blast and explosive effects. Consensus standards would go a long way in ensuring that products purchased by the security community would perform as expected. Until those standards are available, purchasers should discuss performance capability and limitations with the manufacturers and request actual performance test data before purchasing these items.

Image 4. Bottom charge breached Defender model

Image 5. Breached Blastbuster